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Credit Trading: System Documentation & Graphical User Interface Design at Bank of America Merrill Lynch

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Credit Trading: System Documentation & Graphical User Interface Design at Bank of America Merrill Lynch

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By

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Professor Tsung-Yi Wang & Professor Arthur Gerstenfeld
Project Advisors

Abstract

Under Global Credit Products at Bank of America Merrill Lynch our team worked on documenting technology systems and on designing a graphical user interface to display credit product information in the same application. Our role focused on improving the communication between traders and developers in order to facilitate the implementation of a new open sourced platform. The documentation facilitated the systems maintenance and configuration modifications, and the graphical user interface helped traders send market prices to clients more efficiently.

Executive Summary

Bank of America Merrill Lynch is constantly seeking to improve its operations and the technology that supports it. This MQP focused on facilitating the implementation of an open sourced platform, QUARTZ, with the goal of centralizing various systems across the bank into one main database. The Worcester Polytechnic Institute group worked on three projects within the Global Credit Products business group creating documentation of systems and applications, mapping out business processes, and designing a graphical user interface to display the information of credit products.

The first project consisted of documenting the current trading workflow for Bonds and Credit Default Swaps (CDS) for the Credit Sales & Trading (CST) team. With the process flow of the trade cycle within the systems at Bank of America Merrill Lynch, the business analysts within CST will have a better understanding of the integration of the systems. This understanding will allow business analysts communicate the applications issues reported by traders to the developers.

The second project involved creating documentation on the settings and configurations of each system and application maintained by the technology team supporting the Structured Credit Trading (SCT) desk. With the documentation, the SCT technology team can understand the system as a whole and be able to analyze, compare, and change specific settings rather than testing the entire application.

The third project included gathering the requirements and designing a graphical user interface for the Emerging Markets' traders. The interface required the capability of showing both Bonds and CDS trade data in the same application. By designing an interface that summarizes the data of both credit products, the traders would be able to easily send pricing data to external clients and the market overall.

In summary, the overall business value of this project was to facilitate the QUARTZ implementation and help in the design of an interface that would make the process of sending Bonds and Credit Default Swaps prices to clients more efficient.

Authorship Statement

Abstract – Loribel

Executive Summary – Ignacio

Acknowledgements – ALL

Introduction – Luis

Literature Review – Loribel

Methodology – Luis

Results – ALL

Conclusion - ALL

User Interface Design – Ignacio

Workflow Documentation - Loribel

Acknowledgements

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Chapter 1: Introduction

Bank of America Merrill Lynch, based in Charlotte, North Carolina, has undergone various mergers within recent years to accommodate the needs of different clients. Bank of America Merrill Lynch offers a variety of services to three main groups of clients: households, businesses, and institutional investors.

In an effort to strengthen the commitment to clients, the bank provides services that lead to an outstanding customer experience; the business decisions made by Bank of America Merrill Lynch employees need to be based on reliable reports that are accessible. In order for the bank to be better informed globally, improved documentation of business processes needs to be established.

Project Overview

Quality and readily-available data is the backbone for making any sound business decision whether it is for daily trading, business administration, technology development, etc. In response to the different reporting formats resulting from the merger between Bank of America and Merrill Lynch and the Dodd-Frank regulations requirements, an open sourced platform was conceived: Quartz. Quartz allowed for modifications and contributions across all division levels, which facilitated the improvement of the system. This collaborative initiative promotes the involvement and innovation among the Bank of America Merrill Lynch employees; the biggest collaboration they have seen.

This project was a continuation of a business reengineering strategy surrounding the Quartz initiative. Previously, The Global Credit Products – Volume and Market Share Reporting Major Qualifying Project (MQP) from B-Term of 2011 analyzed business level reports to provide a structured plan for the improvement of Quartz. This plan organized the completion of an integrated database for the purpose of understanding Bank of America Merrill Lynch's current risk and position within the

Bonds and Credit Derivatives Swaps (CDS) trade markets. The final objective regarding these applications was to share data effectively throughout Bank of America Merrill Lynch's multinational divisions.

This project built upon the previous MQP with a focus on documenting the systems and processes, and designing a user interface for Credit Trading, a subdivision of Global Credit Products. The purpose of the documentation was to facilitate future understanding of the processes and systems configurations within Quartz; while the purpose of the user interface was to simplify how traders analyzed Bonds and CDS information in Aquila, a subsystem of Quartz.

Problem Statement

With different teams responsible for different Credit products, the establishment of business processes and the development of systems and applications to support those processes were done in a siloed manner. The need to meet changing regulations, such as those requiring transparency from the Dodd-Frank Act, and the need to locate the sources of errors in Credit Technology require a more in depth documentation of the systems and processes.

The lack of a standardized form of documentation for a constantly changing system elongates the process involved to determine the source of errors and for improvement of the system. Knowledge of the system's dynamics was heavily dependent on employees' ability to communicate those processes. Without the documentation, errors in the process are reliant on the availability of the employees to disseminate the knowledge and therefore on its retention rate. In the case that these employees are no longer available, the discovery process begins anew. Documentation, although timely to produce, reduces such a process and improves the understanding of systems and the employee's abilities to improve the system. Without documentation, errors in these systems need to be fixed through investigation into the process which may be more complex than the original problem.

Project Objectives

In order to simplify the current reporting procedures for Credit Trading at Bank of America Merrill Lynch, this project worked on different initiatives of three different areas of credit at the bank: Credit Sales & Trading (CST), Emerging Markets Credit Technology, and Structured Credit Trading Technology (SCT).

The project objectives are threefold:

- Document current processes in Credit Sales & Trading
- Document application configurations for Structured Credit Trading Technology
- Design a graphical user interface (GUI) for Emerging Markets Credit Technology

Chapter 2: Literature Review

Financial Services

The financial services industry, more specifically the banking industry, is "a network of financial institutions licensed by the state to supply banking services" (Darity, 2008). Banking services include storing and transferring money, extending credit, and managing risks associated with different types of capital. Banks also serve as an intermediary party between the ultimate saver and the ultimate user of the funds. Further, banks foster economic activity by charging a small fee associated with the services described previously. For more information on the history of banking and its impact on macroeconomic activity please refer to page 43.

Type of Banks

Table 1 below, lists the major types of banks that are available in modern banking to finance investments:

Table 1 - Types of Banks

Banking Type	Description
Retail	Extend personal credit to consumers
Commercial	Provide short-term credit to nonfinancial businesses
Investment	Underwrite issues of securities
Mortgage	Use real estate as collateral for a loan
Merchant	Extend trade credit internationally
Central	Lend to other banks in need of liquidity

It is very common to find these banking services as part of the services provided by a single bank. For example, JPMorgan Chase & Co. provide retail services to individuals through credit cards,

offer merchant banking to firms that operate internationally, and also issue mortgages and refinancing services to their customers should they need it (JPMorgan Chase & Co., 2012). This project worked under the Global Credit Products division at Bank of America Merrill Lynch, specifically catering to the Merrill Lynch investment banking services.

Regulation

Regulating the areas of the finance industry where there are undeniable private sector advantages, allows the government to intervene in different ways such as conducting monetary policies or extending credit to sectors that will have a greater social impact. Banks are expected to fulfill the reporting and disclosure requirements stated in regulations; examples include the American unit banking rules and interest rate ceilings, which have been established in an effort to control abuses of power and limit its concentration (Darity, 2008)The need for global economies to interact with each other trigger, once again, the concerns of the public interest regarding which industrial structure to choose for the financial needs of each market.

Dodd-Frank Regulations

Under the Dodd-Frank Wall Street Reform and Consumer Protection Act, Over The Counter (OTC) derivatives must be cleared and settled through a Central Counterparty (CCP) (Barclay, Hendershott, & McCormick, 2003). OTC derivatives contracts, similar to CDS, are negotiated bilaterally and subject their users to counterparty default risk. Under the "Wall Street Transparency and Accountability Act, the Commodity Futures Trading Commission (CFTC) and Securities and Exchange Commission (SEC) were given authority to regulate these OTC derivatives. These authorities can choose which transactions are required to pass through organized exchanges or swap execution platforms for clearing.

OTC-cleared derivatives

OTC-cleared derivatives emerged in the late 1990s; during this time clearinghouse organizations began providing clearing and settlement services for OTC derivatives to help those involved in the market manage their credit risk (Barclay, Hendershott, & McCormick, 2003). The benefits to OTC clearing through CCP include: reduced counterparty credit evaluations and ongoing credit exposure monitoring, transparency and consistency of pricing for margin and funds settlements, monitoring or multilateral exposures and correlation risks, default resolution, and default risk mutualization and loss allocation.

The barriers to OTC clearing through CCP include: limited gains for some swap participants from CCP credit exposure monitoring, valuation approach and pricing sources, and margin modeling. Costs imposed by OTC clearing through CCP include: margin and liquidity risk, netting and reliance on short-term funding, excessive standardization, and adverse selection. This project will focus on Credit Default Swaps and Bonds, which are two types of OTC derivatives.

Electronic Trading/Commerce

In the past decade technology has changed in a significant way. This substantial improvement in technology has transformed everything from the way people perform their daily activities to the way the financial industry conducts business, and more specifically has led to an e-trading revolution (Barclay, Hendershott, & McCormick, 2003). E-trading is appealing due to the convenience provided to its customers. A couple of decades ago brokers were indispensable when executing trades; now e-trading, discount, and online brokerages, allow investors to execute and generate trades immediately, at any time and any place. E-trading has increased the efficiency of stock markets and speed of trading, while lowering the cost of trading and facilitating the requirements set in place by the Dodd-Frank regulations.

Being up to date is essential in the financial industry; the faster information and services can be provided, the faster trades can be generated, problems can be solved, and profits can be added to both the client and the broker.

In 2004 the New York Stock Exchange saw itself forced to upgrade its trading operations to an e-trading system, Direct Plus, making an attempt to balance its dependence on floor traders with a growing online trading volume (Barclay, Hendershott, & McCormick, 2003). Similarly, investment banks have shown great interest for the uprising e-trading field. For example, J.P. Morgan developed its MorganDirect single-dealer platform in 2008. The trading platform made has built a strong reputation for the bank due to the level of innovation it entails. James Taylor, global head of e-FX distribution in London expressed the platform's success "MorganDirect Match has attracted interest from a large number of buy-side firms who want to access JP Morgan's flow to get matched, particularly in less-liquid currencies. We can often get better pricing and matching for our clients through this product," (Chakrabarty & Shaw, 2008).

Electronic Communications Networks

Electronic communications networks (ECNs) are essentially electronic markets, the fully automated version of traditional stock markets (Stoll, 2006). The SEC defines ECNs as "electronic trading systems that automatically match buy and sell orders at specified prices" (Barclay, Hendershott, & McCormick, 2003). The idea of a fully automated stock exchange was introduced in 1971 by Fischer Black; the concept had yet to become an integral part of the stock exchange until the SEC adopted Regulation ATS in 1998 that established a framework for alternative trading systems. Working as open limit order books to facilitate trades, ECNs improve quotes by using smaller tick sizes which contrasts the traditional relationships found among market makers and brokers that often bias transactions. ECN use and popularity have grown to the extent that major traditional stock markets have merged with

ECNs in order to be able to compete with other markets; for example, the NYSE merged with Archipelago and NASDAQ bought Instinet (Stoll, 2006). Liquidity has improved due to the emergence of ECNs as they provide additional markets that promote increased dual listing of trades. ECNs are best fit for active stocks and moderately sized trades, otherwise trades require the sponsorship of a dealer to retain liquidity. ECNs are most praised for these advantages: automated trading, anonymity among traders, low cost, speed of transactions, and programming capabilities for future growth and complex orders.

Trends found (Stoll, 2006):

1. Trades on ECNs are smaller than trades with market makers
2. Trades on ECNs are more likely to occur during periods of high trading volume and stock-return volatility
3. ECN trades are more likely to occur when spreads are narrow and with better prices
4. ECN trades are prevalent among stocks with high trading volume, large market capitalization, and fewer market makers
5. ECNs attract more informed traders presumably because of the speed of the transactions

Although competitive and efficient in nature, ECNs still retain the same risks as most electronic automated systems, including glitches and errors (Stoll, 2006). In addition, the main problem around ECNs is their inability to retain the necessary amount of limit orders to assure liquidity. Because market makers are still necessary for larger trades and as agents for the less informed, ECNs remain a complement to the traditional stock markets (Barclay, Hendershott, & McCormick, 2003).

Credit Trading

Credit Trading is the exchange of credit risk exposure of underlying asset or assets between multiple parties (Anson, Fabozzi, Choudhry, & Chen, 2004). The exchange of these credit risk exposures, more commonly known as credit derivatives, can be seen as the purchase of credit protection in the sense that they have the ability to isolate credit risk and manage it independent of underlying bond

positions. Credit derivatives include credit default swaps, asset swaps, total return swaps, credit-linked notes, credit spread options, and credit spread forwards; however, this project within the Global Credit Products division at Bank of America Merrill Lynch specifically focused on the influence of credit default swaps within the bank's technology.

Credit Default Swaps

Credit default swaps (CDS) can be considered as a policy used to hedge against corporate default ((Raunig & Scheicher, 2011)). A CDS is a bilateral contract in which a periodic fixed fee or a one-off premium is paid to a protection seller, in return for which the seller will make a payment on the occurrence of a specified credit event (Gregory R. Duffeea, 2001). Credit events portray a payee failing or unable to make their payment (Stulz, 2010). The 1999 ISDA Credit Derivatives Definitions list credit events as bankruptcy, credit upon merger, cross acceleration, cross default, downgrade, failure to pay, repudiation, and restructuring. CDS is unique amongst derivatives because they are over-the-counter products that are individually negotiated financial contracts. CDS are further classified as single-name credit default swaps and basket default swaps.

Credit derivatives facilitate the shift of credit risk from banks to nonbank investors willing to accept the credit risk for the potential of an enhanced yield, which is the income resulting from the financial investment (Anson, Fabozzi, Choudhry, & Chen, 2004). The pricing of CDS are to reflect the probability of net loss from the default of financial or nonfinancial borrowers. In regards to documentation for a CDS, it identifies a reference entity, the issuer of the debt instrument, or the reference obligation which is the obligation the protection is sought for.

In addition to their transfer of credit risk exposure, credit derivatives create debt instruments that are backed by a reference obligation/asset, entity/issuer, or a basket of reference assets or entities. Examples of these debt instruments include credit-linked notes and synthetic collateralized debt

obligations (CDOs). The influence of CDOs played a significant role in Merrill Lynch's business strategy and its influence has played a vital role in the merger with Bank of America.

Bonds

Bonds are a financial instrument used by an issuer (government, nonprofit, corporation, etc.) in order to raise funds in the present while providing the investor with periodic payments as an incentive (Kuznetsov, 2006). The bond is a contractual agreement between two parties that transfers funds from the investor to the issuer for their commercial purposes; coupons are redeemed periodically as interest and the principal (original) amount is returned upon maturity of the bond. The most common type of corporate bonds is the bullet bond (among puttable, callable, and convertible) where there is a fixed periodic payment, coupon, and the principal is returned at maturity.

Bonds are commonly referred to as fixed-income securities and debt and are included in the asset class along with stocks and cash. An investor in bonds is known as a creditor, they hold higher claims on assets than shareholders in stock (equity) have in the case of a bankruptcy.

Global Credit Products Technology at Bank of America Merrill Lynch

Global Credit Products Technology includes various teams that are responsible for supporting specific credit products for Bank of America Merrill Lynch. This project worked closely with the technology teams supporting the Credit Sales & Trading, Structured Credit Trading, and Emerging Markets. For more background information on Bank of America Merrill Lynch please refer to page 45.

Credit Sales & Trading

The business analysts (BA) on the team bridge the communication gap between the traders, salesmen, and the technology teams in order to effectively implement the business requirements in technology used by the traders. The BAs use their knowledge about the credit e-trading systems and the front office use of such system to identify and prioritize areas that need improvement for the Credit Sales & Trading team.

With this documentation, the WPI group hoped to reduce the communication gaps regarding improvements to the systems, educating new and current hires, as well as the initial goal to facilitate the maintenance of the systems. For example, if the traders reported a problem with an application to the BA, the BA would then be able to look at the documentation and workflows of the system to quickly identify the problem and then effectively describe the issue to the developers. Being able to identify the problem source would expedite the process of identifying the exact source of the problem and the impact the traders would see would be minimized by the developers very effectively.

Structured Credit Trading

The Structured Credit Trading Technology team in New York supports the Structured Credit Trading (SCT) desk. As part of their support to the traders, members of the team collaborate in developing macros in spreadsheets and developments in other applications; these applications ease the work that traders do by simplifying their tasks and reducing the risk of high touch manual processes through automation. The SCT Technology team is constantly involved in developments in Quartz. They configure, create, and maintain different applications that live within Quartz. These applications streamline different processes for the line of business that they support.

The SCT Technology team in New York has three different system environments for each of the applications the team is responsible for. An environment consists of all the technology and process simulators that are necessary to replicate a real system used to contain the data from the market; the SCT team has Development, Quality Assurance (QA), and Production (Market) environments for each application. For example, traders use an application called Odin to submit the pricings of bonds. When developing new features, the software developers use the Development environment. When testing how the system integrates with other systems, or when doing user acceptance testing, the QA environment is used. Lastly, the environment used by the traders and to store the marked data is the Production environment.

The objective of the documentation was to provide the SCT Technology team with an understanding of system interactions and facilitate the maintenance of the system applications across the three different environments. By doing so, SCT Technology team would be able to analyze the different configurations and settings of each of the system across all environments and do the proper modifications if needed.

Emerging Markets

The purpose of the Emerging Markets division within Bank of America Merrill Lynch is to increase the bank's presence in countries that have an upraising economy, with projections of future growth. The emerging nations are known for their rapid development and industrialization. As a result countries such as Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, and Venezuela are among the clients with whom the team is constantly dealing with. Nevertheless, the division works with clients from all around the world, that are interested in investing in these Latin American countries and their promising economies. The Emerging Markets division offers a variety of credit products, with the goals of maximizing portfolio gains for each of the division's clients, creating markets, and creating profits for

the organization. The products that are offered on a frequent basis are bonds and its derivatives, such as Credit Default Swaps (CDS).

The WPI group worked with Bank of America Merrill Lynch's Emerging Markets Credit Technology team. The main purpose of this team was to provide strategy trading tools, such as trading applications to help making the CDS and Bond market-making process more efficient by rapidly providing clients with price runs. Runs are reports that contain the prices of the bonds and credit default swaps that the traders offer to their respective clients. As a result, these runs are sent to clients with the main purpose of informing them about the most up to date prices of their fixed income and CDS investments.

Originally in Aquila, the Quartz subsystem described in Chapter 1, current bond information was not being displayed with the CDS data on the same application. Designing a user interface that could show CDS and Bonds trading data on the same interface in Aquila would ease the trading process from a trader's perspective.

Chapter 3: Methodology

Project Design

As it was described on page 20, the WPI group collaborated with three different teams within Credit Trading Technology. The work done for Credit Sales & Trading (CST) and for Structured Credit Trading (SCT) Technology included creating documentation of existing systems and procedures. In addition, the work produced for Emerging Markets included designing a new user interface for an existing system.

Documentation Design

Documenting was done in four steps: before documenting, while documenting, after documenting, and publishing all documentation. Table 2, displayed below, outlines the four parts of the documentation, underscoring the steps taken in each stage, and the deliverables for each of them.

Table 2 - Documentation Plan

Phase	Step	Technique	Deliverable
Before Documenting	Identify the problem	Speak to team members for requirements	None
	Gather background information on the system	Read current documentation if available	Documentation template
	Create a timeline	Identify all tasks, estimate time needed per task	Timeline (Gantt Chart)
	Collect business / system requirements	Interview employees, document business processes	System Requirements, System Definition
While Documenting	Model system processes	Diagram data flows for processes	Process Workflow
	Document system procedures	Break the workflow into chronological steps	Detailed step by step documentation

Phase	Step	Technique	Deliverable
After Documenting	Verify Documentation Accuracy	Meet with team members to obtain their approval	Finalized version of the documentation
Publishing Documentation	Store documentation	Upload documentation to the bank's central wiki or save it in shared drives	Final documentation handoff

(Dennis, Wixom, & Roth, 2009)

Graphical User Interface Design

The design of a graphical user interface incorporating the Bonds and CDS prices for Emerging Markets was broken down into four phases: planning, analysis, design, and implementation, with the objective of creating UI requirements that actually represent the businesses needs and are clear to understand in order to avoid issues during development. Emphasis was placed in describing user scenarios, maintaining Aquila aesthetics, documenting the storyboards flow, and the engineering evaluation. (Landseadel, 1995). Table 3, displayed below, outlines the four parts of the interface design, showing the steps taken in each stage, and the deliverable for each one of them.

Table 3 – User Interface Design Plan

Phase	Step	Technique	Deliverable
PLANNING	Identify the problem	Speak to Emerging Markets team for further understanding	None
	Gather background information	Research on UI, and current platforms used within the organization	None
	Create a timeline	Identify all tasks, estimate time needed per task	Timeline (Gantt Chart)
ANALYSIS	Collect business requirements	Interview employees	System Requirements, System Definition
	Style Guide	Follow current system aesthetics	None

Phase	Step	Technique	Deliverable
	Create various use cases	Develop use case analyses	Use Cases
	Storyboards	Develop storyboards to identify problem areas	Storyboards
DESIGN	Design user interface	Consider use scenarios, then structure interface	Interface Design
	Test user evaluations	Usability testing, evaluate with heuristics	Design improvements
IMPLEMENTATION	Engineering Evaluation	Comparison of the design requirements and the UI design compatibility	Team feedback
	Project hand-off	Set up for addition of new processes, etc.	All compiled system information documents

(Dennis, Wixom, & Roth, 2009)

Scope

Credit Sales & Trading

Our team worked in collaboration with Credit Trading Technology Business Analysts in order to document some of the processes that are currently in place within the division. The scope of our project reaches out to the e-trading teams, with a particular focus on Bonds and CDS. The WPI group created a workflow that mimics the reporting process of CDS and Bonds and documented it with step by step instructions. The template used by the WPI group to document each application can be found in page 57.

Structured Credit Trading

In collaboration with the SCT Technology team, the WPI group was responsible for the documentation of QVol and its REST service, Bonds Option Vol, CDO^2 Calibration Tool/Random Factor Loading (RFL), and CDO Evaluated.

The main objective was to document the settings and configurations of the different parameters of each system for each of the three environments (Production, QA, and Development), and display how each individual part of the systems interacts with each other by the creation of a workflow of each system. The template used by the WPI group to document each application can be found in page 58.

Emerging Markets

The WPI group worked with a Business Analyst from the Emerging Markets Credit Technology team to develop the design of a graphical user interface that incorporates credit default swap (CDS) trading data on Aquila's screen along with bond market data.

Deliverables and Timeline

Table 4 lists each core deliverable for the project and the deadline by which it was due.

Table 4 - Deliverables and Timeline

Deliverable (for both Bank of America Merrill Lynch and MQP)	Deadline
Proposal Presentation	October 22nd
Cash and CDS Workflow Documentation • ***Deliver finalized version of workflow documentation.***	November 5th
Structure Credit Trading Technology Systems Documentation • ***Deliver finalized systems' documentation.*** • ***Input final document on Bank of America Merrill Lynch's Wiki page.***	November 16th
Emerging Markets' Graphical User Interface • ***Design sample graphical user-interface.*** • ***Deliver final business requirements and design specifications to developers for approval.***	November 30h December 3rd
First Draft (MQP Paper)	December 4th
Final Draft (MQP Paper)	**December 11th**
Final Presentation to sponsor	**December 12th**

Work Plan

Figure 1, Figure 2 and Figure 3 show the general work plan for the projects at Bank of America Merrill Lynch. Each major task in the project plan required numerous steps. Although each student was not involved in each step, the overall task as a whole was reviewed and edited by the input generated by all students. A summary of the weekly reports sent to the project advisors can be found in page 51.

Timeline

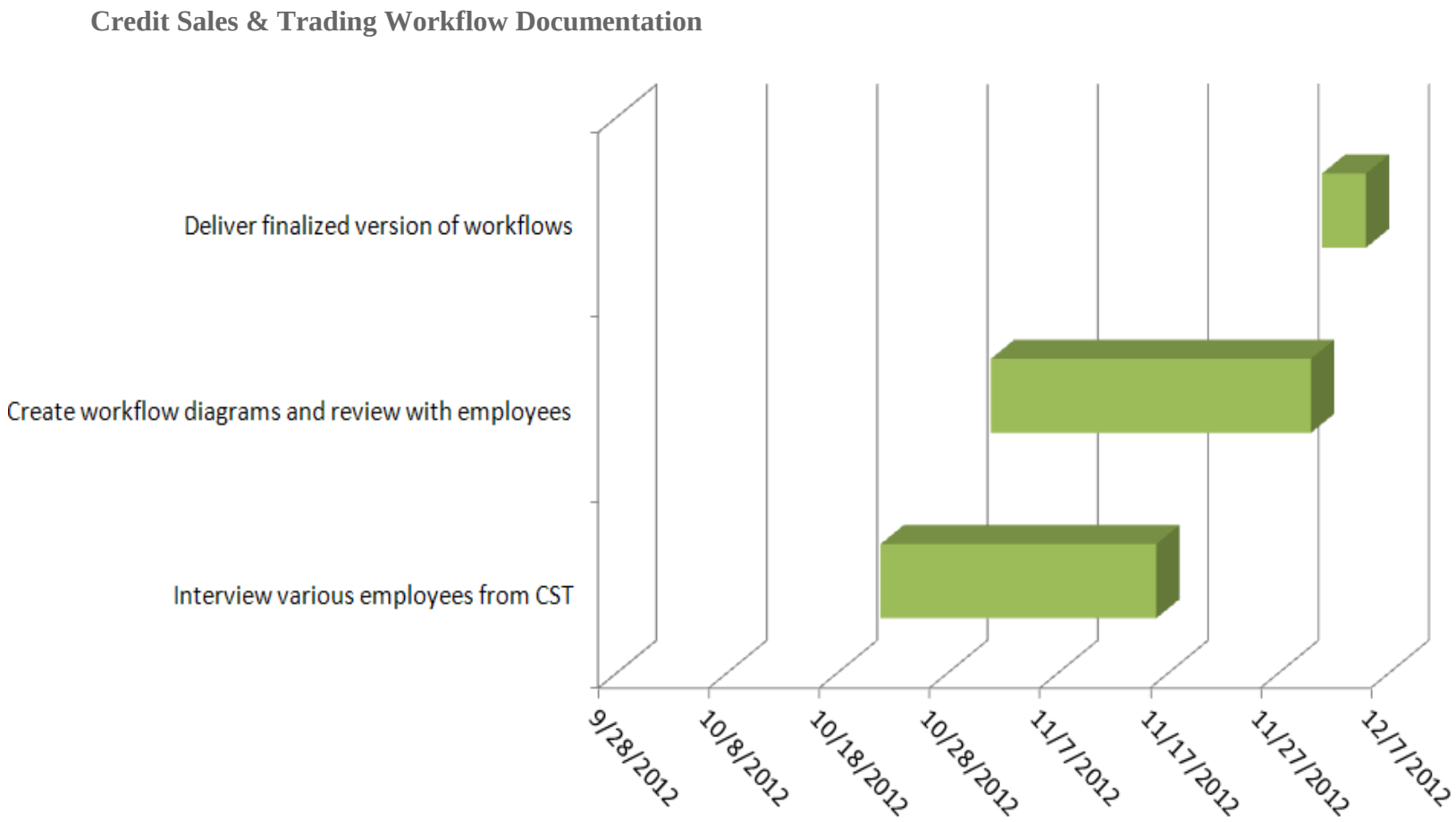


Figure 1 - CST Workflow Documentation Timeline

Structure Credit Trading Technology Systems Documentation

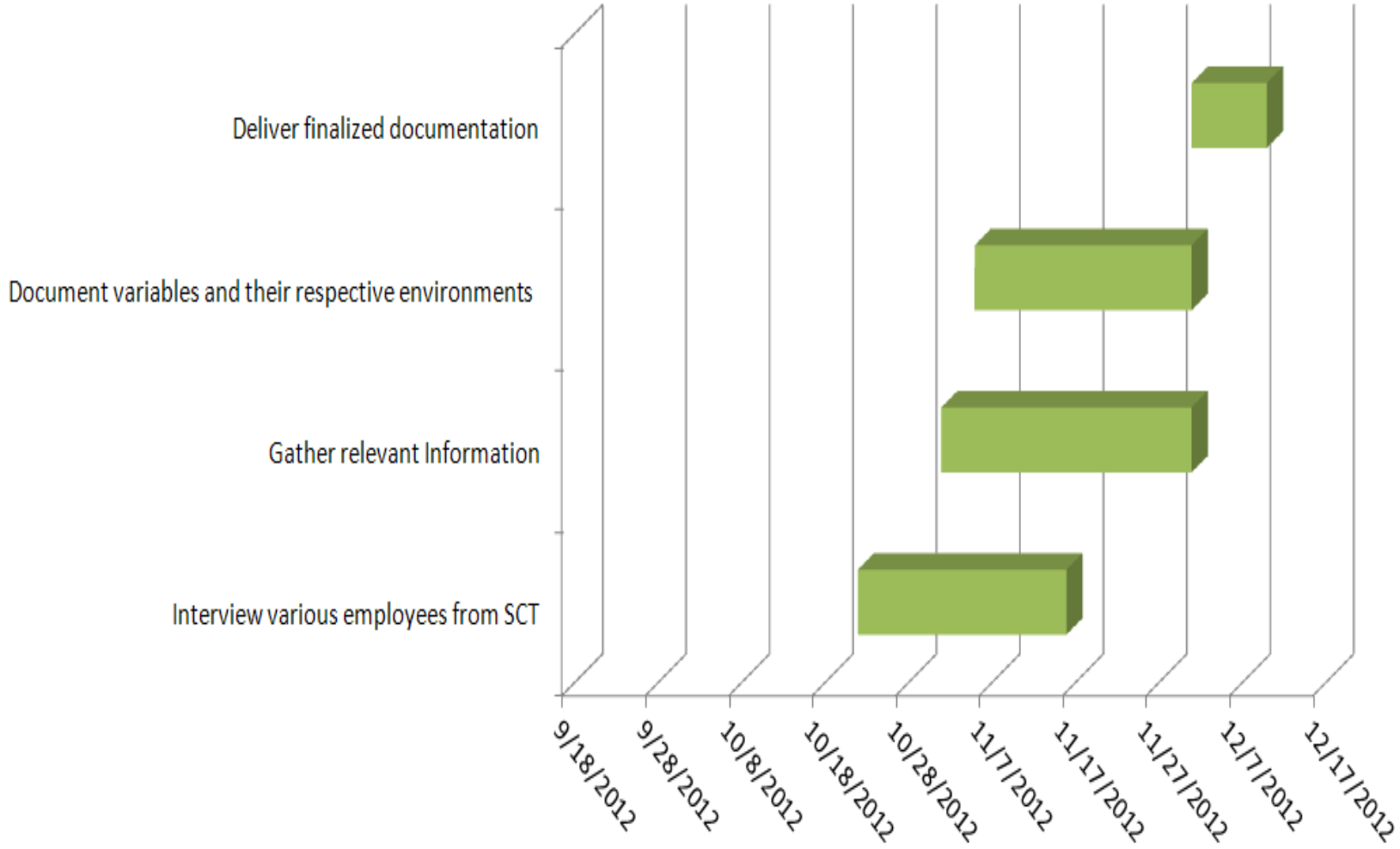


Figure 2 - SCT Systems Documentation Timeline

Emerging Markets' Graphical User Interface

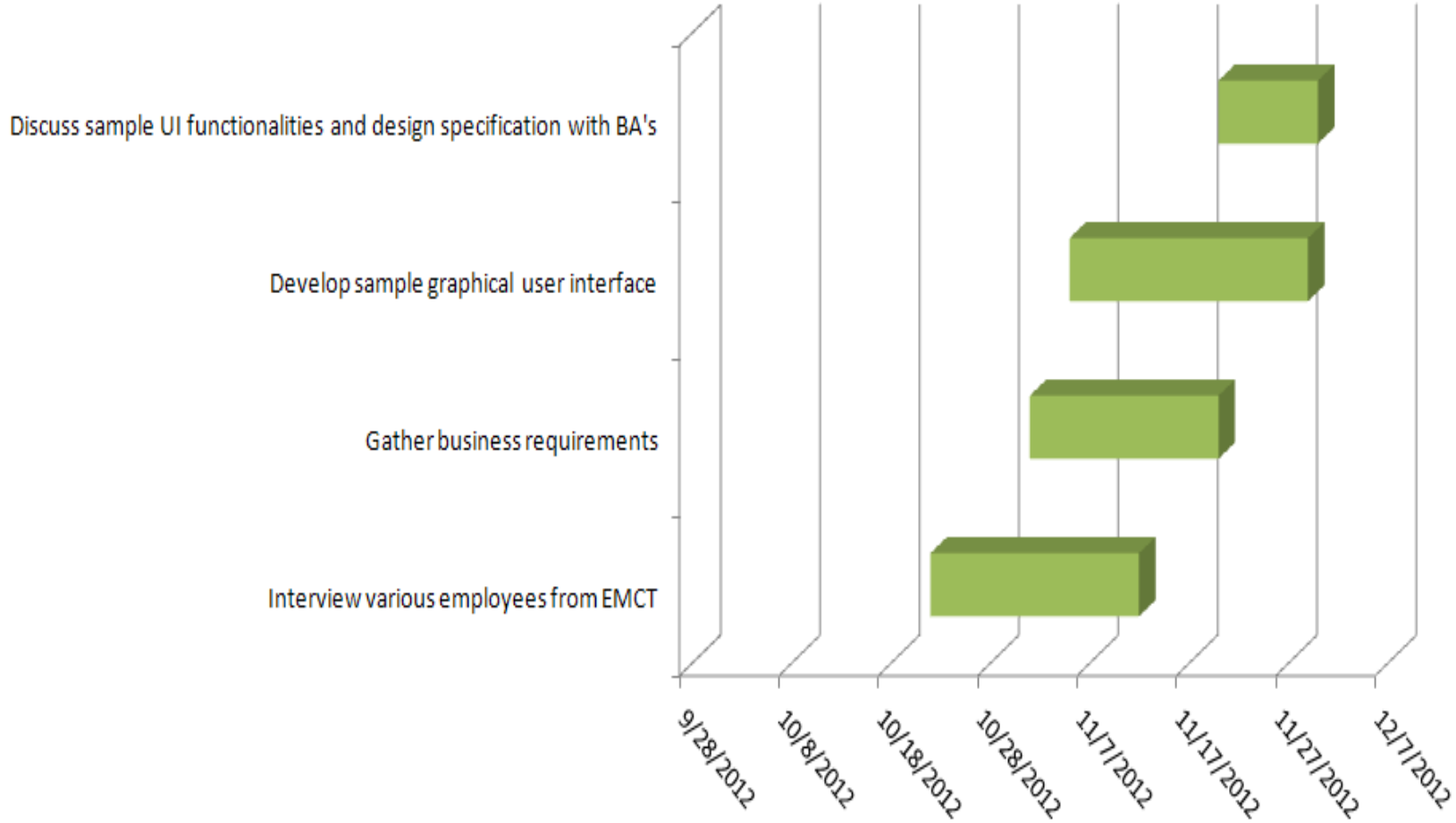


Figure 3 - Emerging Markets User Interface Timeline

Staffing Plan

The following section reviews the project-related skills and experience that each team member has amassed to the date of this report. The section also provides the project sponsors with confidence that the project will be completed (at the very least) to their expectations.

Loribel Corpuz

Loribel Corpuz is majoring in Management Engineering with minors in Mathematics and International Studies. Outside of school she volunteers as a sustainability consultant for the Worcester Sustainable Business Leadership Program. Her involvement with this program has given her experience consulting a client. The research required to prepare for consultations have allowed her to direct solutions based on the clients' requirements efficiently. For the Habitat for Humanity client, preparation allowed her to ask the right questions and inform the client about beneficial solutions which completely redirected the project to a solution that would prove more beneficial; similar to the Situation, Problem, Implication, and Need-Payoff model Bank of America Merrill Lynch employees use during consultations with their clients. In addition, the initiative she took at her summer internship at Absolute Green Energy to produce informative PowerPoint narratives have strengthened her skills with the Microsoft Office Suite.

Ignacio Davila

Ignacio Davila is majoring in Industrial Engineering. His major has provided him with the knowledge required to understand how the engineering and management aspects of a business work together. As a result, he has focused his academic work in understanding best practices to improve processes and optimize operations within a business to reduce costs and

increase efficiency. Ignacio worked on a 10-week project developing trading systems for the FX Market using the TradeStation trading platform. This project gave him a comprehensive understanding of how financial markets work.

Luis Quiroga

Luis Quiroga is double-majoring in Management Information Systems and Industrial Engineering. With this combination he can understand both the flow of business processes and the technology and data that go into each part of each process. His coursework in Systems Analysis and Design, Business Data Management, and Information Systems Management will all assist the team in getting this project done. In addition, he interned twice for Goldman Sachs and once with Fidelity Investments. These jobs gave him the experience to work in a fast-paced environment in the finance industry, and also work with other tools to enhance business processes.

Stakeholder List and Roles

Each individual who contributes to the project or will be affected by the project is a stakeholder. The most notable stakeholders are the project sponsors, the WPI group, the faculty advisor, and the various points of contact within the project. An overview of each stakeholder is described in Table 5.

Table 5 - Project Stakeholders

Name(s)	Title, Department	Project Role	Responsibilities
Loribel Corpuz Ignacio Davila Luis Quiroga	WPI MQP Team	Project Managers, Project Team	Produce MQP Report
Professor Wang and Professor Gerstenfeld	WPI MQP Team Advisor	Faculty Advisor to project team	· Keep track of team progress · Provide guidance throughout the process

Name(s)	Title, Department	Project Role	Responsibilities
Jason Tondreau	Associate Trading Strategist, CST	Project Sponsor	Organize responsibilities for the duration at Bank of America Merrill Lynch
Ron Toam	Vice President for SCT	Project Co-Manager	Assign deliverables
Caitrin Donnelly	Assistant Vice President for Emerging Markets	Project Co-Manager	Assign deliverables
Michael San Jose	Vice President	Educator	Explained QVol Environment Literals
Swathi Kammela	Contractor for London's Emerging Markets	Bridge	Contact for the London Emerging Markets Traders
Mike Elmore	Assistant Vice President	Educator	Provided background on KDB
Ekaterina Hilario	Credit Trading Desk Analyst	Educator	Explained usage of ODIN
Kyle Geder	Credit Trading Desk Analyst	Educator	Provided a Credit Crash Course for background in the industry
Andrew Hopkinson	Assistant Vice President developer for CST	Educator	Explained the process of writing CDS and Bonds into the VolumeDB
Jin Lee	Assistant Vice President for SCT	Educator	Provided general overview on QVol documentation parameters
Chenchen Zhang and Luyang Zhang	Second WPI MQP Team	Educator	Provided overview on the coding of CDO^2

Risk Assessment

Table 6 provides a description of potential risks that may hamper the successful completion of the project objectives in the timeframe established for it.

Table 6 - Risk Assessment

Risk	Risk Level	Impact	Description
Employee unavailability	Medium	High	Meeting with various employees is how we will document processes and gather the requirements for the user interface. If any of the meetings need to be rescheduled for any reason, the documentation will take even longer than expected.
Prior document consistency	Medium	High	Some documentation existed prior to our arrival. In order for our deliverables to be effective, our documentation must include the existing one when showing the overall picture.
Technology availability for presentation	Low	Medium	If no projector or other technology source is available for the final presentation, it could hinder the quality if the student team is ill-prepared.

Risk Mitigation

The risks listed below have all been recognized and the following section describes the way(s) in which the risks can be avoided or counteracted.

Technology Unavailability for Final Presentation

For the final presentation, we planned on having backup computers available to connect to the projector to display the presentation. In case the projector was unable display our presentation, we provided handouts of the slides in the room to avoid not having a visual aid for our presentation.

Employee Unavailability

As with any interview or business meeting, a time had to be arranged that worked for several different groups of people. To reduce the risk of not being able to meet in the near future,

we scheduled meetings in advance and had various parts of the three projects going on simultaneously, in case one came to a halt we could still advance in the other ones.

Prior Document Inclusion

Partial documentation existed portraying some of the workflows and applications that we documented. When meeting with employees to understand the current processes and systems, we would search for any existing documentation in the internal wiki of Bank of America Merrill Lynch prior to going to the meetings, in order to be able to analyze how it would integrate with our overall workflow.

Chapter 4 – Documentation & Graphical User Interface Implementation

This section covers the outcomes of the project after the time the WPI group was onsite.

Documentation

After seven weeks on-site, the WPI group documented the configuration of four applications of the SCT technology team, and created the workflows with step by step instructions for the CST business analyst. The documentation proved to be useful immediately after it was created. The SCT technology team was able to identify differences in settings and configurations in some applications and was able to make modifications accordingly, while the business analyst for CST referenced the workflow diagram to identify the source of a problem the traders were facing with an application.

Credit Sales & Trading

The WPI group created the workflow portraying the trade life-cycle within the systems of Bank of America Merrill Lynch for Bonds and CDS. The workflows were approved by Jason Tondreau for use in Credit Sales & Trading. The documents will be used to identify the source of credit trade errors which will help the CST team contact the employee responsible in order to resolve the issue, thus reducing the time originally spent investigating the errors origination. Additionally, the document will prove to be a reference point for internal inquiries and to use as a basis point for improvements to the system.

The settings and configurations for QVol and its REST service, Bonds Option Vol, CDO^2 Calibration Tool/Random Factor Loading (RFL), and CDO Evaluated, across the three environments used by the SCT Technology team, were successfully documented: all documentation was revised by Ron Toam to be then uploaded to the central wiki at Bank of America Merrill Lynch. With the documents created, the WPI group expects that maintaining the systems will become easier and faster. The documentation will also help maintain the knowledge and understanding of the application configurations within the team, making it easier to compare the settings across the environments.

Graphical User Interface Implementation

The WPI group collaborated in the design of a graphical user interface (GUI) for Emerging Markets Credit Technology to show CDS and Bond market data on the same application. Once the GUI is developed, it will allow traders to enter pricing information in Aquila and be able to select which credit product to show between CDS and Bonds. Once they have made their selection, the screen will update automatically to display real-time market data on the product that is being traded. The trader will have the possibility to send a run from that screen based on the predefined format and template of each of the products.

The storyboards below show how the traders would access the Bonds or CDS screen and related trading information. The process would consist of three steps, where the first step portrays the opening screen for the platform. Traders would then have the option select either the bond or CDS information. The new GUI will allow the traders to switch between the bond and CDS screens. For a closer look at each interface please refer to page 59.

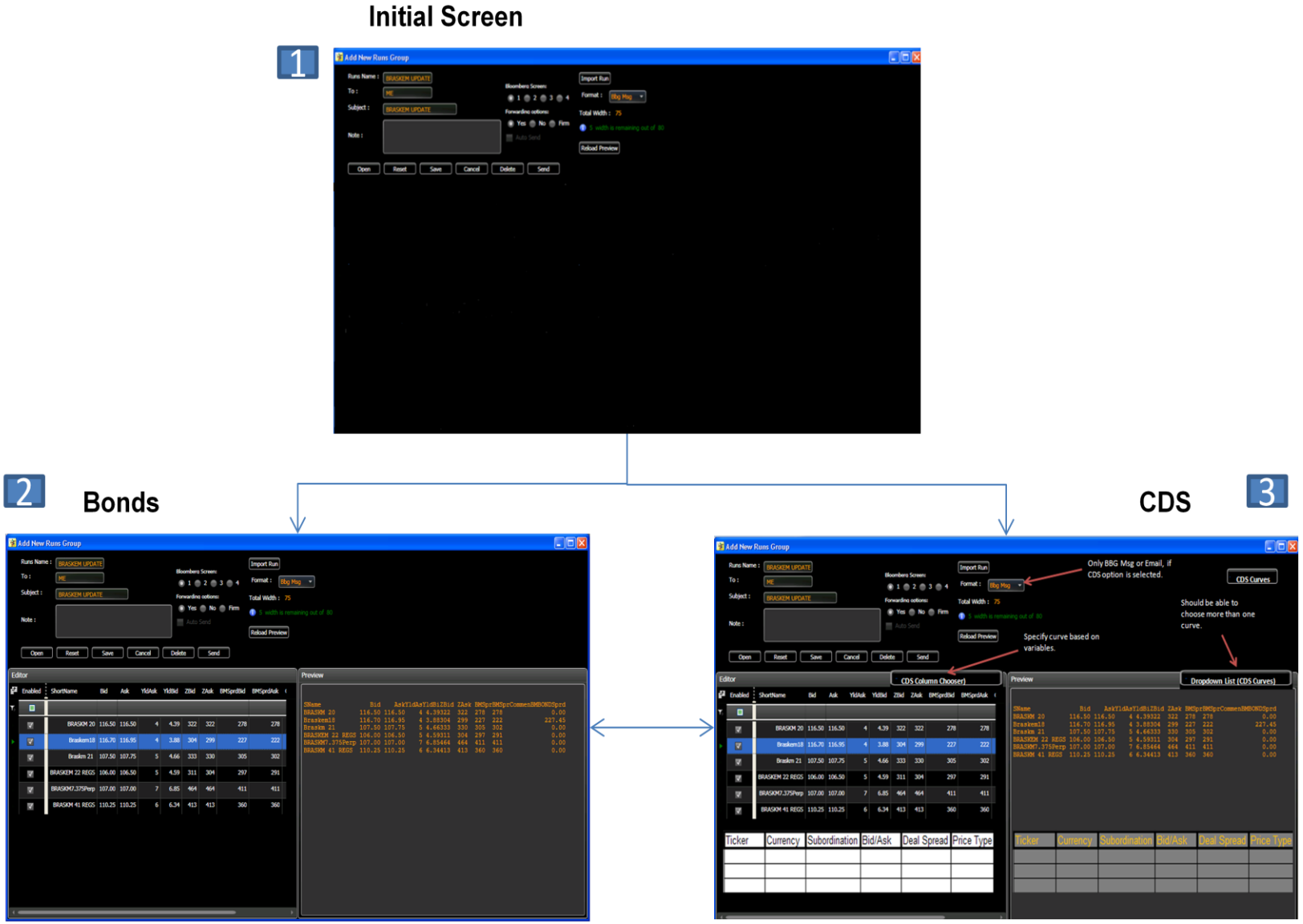


Figure 4 - User Interface Storyboards

Chapter 5 – Recommendations & Conclusions

This section provides an overview on ways to implement our deliverables and recommendations based on our experience working in the Global Credit Products business group at Bank of America Merrill Lynch.

Recommendations

Documentation

We recommend that Bank of America Merrill Lynch include documentation as part of the day to day tasks that employees are responsible for. We believe that this addition to their responsibilities will increase the efficiency of the employees themselves and the bank in the long run. With standardized documentation, employees can use them as reference for internal inquiries and therefore reduce the time spent explaining processes to inquirers. With this, employees will be able to reallocate their time from explaining their respective processes, to improving their systems and taking on new projects that queue up waiting for leads. The documentation would be stored in the internal wiki, which would therefore become a more efficient search tool for knowledge of the systems and prove to be an effective addition to the bank in a deeper level than what it currently provides employees with.

Emerging Markets GUI

The WPI group designed the graphical user interface to serve as a guide for developers when coding so they will be able to create an interface that includes the functions described in the design. We recommend that more conversations between the developers and the business

analysts take place before the application is available for the traders to use; developing the interface in a manner that satisfies the traders' requirements will facilitate the interaction of the traders with the application, making them more efficient at their communication with the bank's clients.

Conclusions

In order for Bank of America Merrill Lynch, or any company, to be able to improve its technology it is necessary that proper documentation is established and business requirements are communicated to developers effectively, in our case through the design of a graphical user interface.

Documenting business procedures allows knowledge to stay in-house and facilitates a high level understanding of how everything interrelates, especially when attempting to implement change into the organization. Standardized documentation reduces the risk of losing the knowledge of the processes of internal systems that give Bank of America Merrill Lynch its competitive advantage.

Graphical user interfaces that satisfy the business requirements require a long process of extensive communication. Creating a graphical user interface does not require extensive technical skills; however, an interface that is not intuitive or does not satisfy the business requirements will not add any value to the business and will have a counterproductive effect in the operations. Gathering detailed requirements prove tedious, but developing the interface right the first time will provide a lot of aggregated value to the business.

Moving away from the project itself, the opportunity to be involved in this project at Bank of America Merrill Lynch proved to be a very valuable experience. Being able to apply the theory learned in school to the financial industry was an eye-opening experience. Issues in a

corporate environment differ from case studies reviewed in school, where systems or processes do not work and a specific procedure is needed to solve it; in the corporate environment people skills prove to be very useful. Being able to balance other people's busy schedules with our priorities was definitely a challenging task.

Appendices

Appendix A – Financial Services Background

History of Banking

The various services listed in the section above are relatively modern, even though various aspects of banking have existed for centuries. Storing wealth and lending credit go back in time to transactions involving gold, cattle and grain, or currency exchanges based on the weight and purity of metals.

Over time, finances involved different personalities such as individual moneylenders involved in merchant trade and commerce, as well as debt issuers for royalties seeking means to sustain colonial expansion. The industry evolved into banks managing national debt, while being supervised and managed by the state.

A consistent theme throughout banking history has always been the interest of the general public to minimize the risk of financial difficulties by challenging financial power, which has led to various notorious enhancements of the banking industry regulations (Darity, 2008).

Macroeconomic Activity

When looking back into previous financial crises and analyzing the events that trigger them, "there is substantial agreement on the fact that there exists an important relationship between a sudden contraction of credit and liquidity and a considerable decline in economic activity" from very highly regarded personalities representing different backgrounds in the financial industry, such as Ben Bernake – Chairman of the Federal Reserve, Milton Fredman –

Nobel Memorial Prize in Economics, Anna Schwartz – President of the Western Economic Association International, and Charles Kindleberger – historical economist (Darity, 2008).

Sudden instability in one part of the world will inevitably impact markets in a completely different time zone further affecting other markets of their own, creating a domino effect. For example, the failure of the Credit-Anstalt bank in Austria triggered a withdrawal of credit in New York which impacted banks throughout the country, as it was stated by Kindleberger.

On the other hand, "the proliferation of the number and variety of financial institutions and a substantial rise in the ratio of money and other financial assets relative to total output and tangible wealth are 'apparently universal characteristics of the process of economic development in market-oriented economies'" (Cameron, Crisp, Patrick, & Tilly, 1967).

In order to finance larger capital projects, larger amounts of funds are needed; this need forces inefficient informal financial systems to transform into efficient formal transactions. With the objectives of promoting stability and growth, determining which industry model manages the risk of banking crises is certainly a challenge.

Appendix B – Bank of America Merrill Lynch

Bank of America Corporation opened by A.P. Giannini in 1904 in San Francisco under the name of Bank of Italy, with the purpose of serving the needs of the growing immigrant population which had been denied by other banks. Two years later, Bank of Italy was devastated when an earthquake and a fire hit San Francisco. Fortunately, the vault of the bank remained intact which allowed the bank to become a major force in rebuilding the city by sustaining businesses through loans. One of the lessons learned by Giannini was the importance of branch banks to protect against future crises. Giannini's conclusion lead to the production of various branches across the state of California, which would revolutionize the clearing system in the United States.

Throughout history Bank of America has been a major player in events that have contributed to society. For example, Bank of America extended the first loan to the film industry, which was considered a risky investment. With the loans provided by the bank to fund producers such as Columbia Pictures and Twentieth Century Pictures, films such as Wuthering Heights, Gone With the Wind, and Snow White and the Seven Dwarfs were recorded with the bank as the main economic support. In addition, Bank of America aided with the cost of World War I by purchasing millions in Liberty Bonds. Also, the first solo nonstop trans-Atlantic flight done by Charles Lindbergh was financed by the bank. To rescue the economy in 1931, Bank of America took the first issue of bonds to build the Golden Gate Bridge; the issue of bonds raised $6 million and inspired the confidence to collect $35 million for the project. Similar to World War I, the bank helped finance World War II by selling wartime securities and Victory Loans.

With the increment of the US population in the 1950s, Bank of America partnered with Stanford Research Institute to develop the Electronic Recording Method of Accounting and the

Magnetic Link Character Recognition. The resulting product reduced check processing time by 80% and revolutionized the banking industry once again. In 1958 the BankAmericard was created as the first nationally accepted general-use credit card, which would later change its name to VISA.

In only 11 years the bank underwent five different mergers and acquisitions that would change the bank drastically by expanding its portfolio of banking services. Starting in 1998, BankAmerica Corp. was acquired by NationsBank, making it the first coast-to-coast retail banking franchise. After the acquisition there were banking centers across 22 states and D.C. with offices around the world under the name of Bank of America. Following the merger with NationsBank, Bank of America purchased FleetBoston Financial Corporation in 2004, making the bank the first nationwide bank after extension of the franchise throughout the Northeast. In 2006, MBNA, the largest credit card issuer in the industry, was acquired. US Trust was acquired in 2007, expanding the services of Bank of America in the aspects of private banking business and private wealth management. Lastly, in 2009 Bank of America acquired Merrill Lynch making it a major player in the investment banking sector. (Bank of America Corporation;, 2012)

Today, Bank of America Merrill Lynch has 5,600 branches and 16,200 ATMs spread across 150 countries. Bank of America Merrill Lynch has business with 99% of the U.S. Fortune 500 companies and 83% of the Fortune Global 500. As of 2010, Bank of America Merrill Lynch was the thirteenth-largest company in the U.S. and is publicly traded in five of the biggest markets in various locations around the globe (Cable News Network, 2012).

Vision

Bank of America Merrill Lynch's vision is to "become the finest financial services company" (Bank of America Corporation;, 2012). In order to execute their vision, the bank has

defined three key aspects necessary for their success: Diverse global workforce, employee well-being and benefits, and diversity.

Being a multinational company requires a diversified workforce that can understand and act across different cultures combined with an open communication channel across all levels of the bank's hierarchy. Bank of America Merrill Lynch has been a leader in offering solutions to their workforce's needs outside of the company, such as healthcare, retirement, and compensation.

Talent is at the core of Bank of America Merrill Lynch's workforce. They invest numerous resources to ensure human capital is sustainably maximized. In addition, the bank offers various incentives to develop employees both as individuals and professionals through benefits and training.

Bank of America Merrill Lynch has been recognized numerous times for their efforts in promoting inclusion and being an equal opportunity employer. Bank of America Merrill Lynch has received corporate awards for promoting a healthy work-life balance. Efforts of employees that represent the company's core values or obtain unexpected achievements are praised. Employees that go beyond expectations are given gift cards or appreciation points as a reward for their results. There is a clear commitment with their employees that gives them opportunities to obtain grants for organizations they volunteer at.

Global Impact

Bank of America Merrill Lynch, as a global business, strives for positive impact with its involvement in the communities it does business.

The bank tries to strengthen economies by lending, giving, and investing in programs such as funding nonprofits projects or simply members in the community that are in need.

Similarly, the bank leads and serves by sponsoring leadership programs for nonprofits and individuals so that they can obtain the tools and resources to have an impact in the community.

Bank of America Merrill Lynch works towards environmental objectives and they have done this by allocating funds towards environmental activities that address climate change and attempt to reduce our carbon footprint. There is also a big emphasis on arts and culture for which Bank of America Merrill Lynch have designed conservation programs to engage people in creative ways to promote mutual respect and understanding, benefiting both economies and societies.

Credit Ratings

Bank of America Merrill Lynch has obtained very high ratings on its financial strengths, as it can be seen below in Figure 5. These ratings show that Bank of America Merrill Lynch is a competitive bank with a strong financial position in the market.

(Ranked by S&P rating; (S)=stable outlook, (N)=neg, (P)=pos)

	Standard & Poors	Moody's	Fitch
BNP Paribas	AA- (S)	Aa3 (N)	A+
HSBC	AA- (S)	Aa2 (N)	AA
Banco Santander	AA- (N)	Aa3 (N)	AA-
Barclays	A+ (S)	Aa3 (N)	A
Credit Agricole	A+ (S)	Aa3 (N)	A+
ING Bank	A+ (S)	Aa3 (N)	A+
JPMorgan Chase	A+ (S)	Aa3 (N)	AA-
Societe Generale	A+ (S)	A1 (N)	A+
Credit Suisse	A+ (N)	Aa2 (N)	A
Deutsche Bank	A+ (N)	Aa3 (S)	A+
Lloyds BG	A (S)	A2 (N)	A
RBS	A (S)	A3 (N)	A
Bank of America	A (N)	Baa1 (N)	A
Citigroup	A (N)	A3 (N)	A
Commerzbank	A (N)	A2 (S)	A+
Goldman Sachs	A (N)	A1 (N)	A
Morgan Stanley	A (N)	A2 (N)	A
UBS	A (N)	Aa3 (N)	A
Unicredit	A (N)	A2 (N)	A

Figure 5 - Credit Rankings

Personal, Small Businesses, Wealth Management, Businesses & Institutions

Personal

Bank of America Merrill Lynch's personal banking service is focused on the individual consumers. Bank of America Merrill Lynch's primary goal is to provide the customers with an outstanding experience at all times. Consequently, it offers products such as credit cards, travelers checks, insurance, wealth management and investing. (Bank of America Corporation, 2012)

Small Businesses

Bank of America Merrill Lynch's Small Business section is dedicated to providing top services to customers who own small businesses defined as corporations that operate independently and have between 500 to 1000 employees. Its products provide aiding tools to manage funds in an organized and efficient way, for the purpose of guaranteeing a structured business experience, and keeping the finances simple and secure at all times. Some of the products are business checking accounts, business credit cards, health insurance, and merchant services.

Wealth Management

Bank of America Merrill Lynch's Wealth Management group is in charge of providing one of the best financial advice, planning, and solutions to its high net worth clients: individuals that retain at least $1 million of investable assets. With Bank of America Merrill Lynch's unique approach, customers can rest assured that experts in the field are managing their wealth and assets correctly, and are making decisions based in the clients' best interest.

Businesses & Institutions

Bank of America Merrill Lynch's Business & Institutions sector is geared towards making its clients discover the best opportunities available to deepen customers' market insight,

increase cash flow and operational efficiency, increase capital gains, and produce an intensification in product impact. Due to the broad range of clients that this section entails, the bank's products are divided into two categories: Small to Midsize Businesses and Corporations and Institutions. Small to Midsize Businesses serve industries such as Agrobusinesses, Education, Law Firms and the Government, while Corporations and Institutions serve Energy and Power, Gaming, Healthcare and Consumer, and Retail amongst others.

Appendix C – Weekly Project Reports

Weekly Report 11/05/2012

What have you accomplished during your first week?

- Mapped the current process for the Cash and CDS workflow. This essentially described how a traders volume is added to the Bank of America Merrill Lynch Volume Database for storage
- Created a PivotTable to confirm that the CDS data between a Legacy Java platform and its transfer to the new Quartz platform were identical
- Meetings to learn about KDB, Aquila,
- Meet our developer team in One Bryant Park (OBP)
- Project progress meetings with Ron and Jason.

What is your plan for the next week?

- Complete Mapping of Cash and CDS workflow.
- Mock user interface prototype for indexed options database (essentially proposed workflows)
- Fill out a QVol Environment Diagram and create a PowerPoint to put on a wiki to keep track of the environment status

Have you encountered any problems this week?

- Hurricane Sandy.

Weekly Report 11/09/2012

What did you accomplish this week?

- We finished the mapping of the CDS and Cash workflows for Jason.
- We also created mapping tables for Indexed Options literals, which was asked by Ron Toam.

What are your goals for next week?

- Under Jason's supervision, we will create a workflow map of E-trading processes.
- Start the design of a GUI that incorporates the CDS information in AQUILA (pricing application)

Did you encounter any problems throughout the course of the week?

- Not really. Things have been flowing well, and we have kept up with our deadlines.

Weekly Report 11/15/2012

What did you accomplish this week?

- We already scheduled our MQP meeting room for the final presentation, we will send the meeting invite once we have all the details.
- We finished the documentation regarding Ron's mini-project.
- Kyle Geder gave us a credit crash course, explaining in more detail the role of the credit trading division and overall impact on the organization.

What are your goals for next week?

- Create a mock Graphical User interface (GIU) for the Emerging Markets Division, which can successfully show on the same window Bond's and CDS' data parameters.
- Begin working on the E-trading workflow, Under Jason's supervision.
- Do Bobjob for Ron Toam. This is our newest deliverable.
- We will be practicing our 5 minute presentation for the Alumni event.
- Continue working on methodology.

Did you encounter any problems throughout the course of the week?

- Our project-liaisons have been very busy this week, so we haven't had enough time to meet with them, in order to get more details regarding our deliverables.

Weekly Report 11/20/2012

What did you accomplish this week?

- We already scheduled our MQP meeting room for the final presentation, we will send the meeting invite once we have all the details.
- We finished the documentation regarding Ron's mini-project for the first application, and are now working on documenting more applications using the same format.
- We discussed the GUI specifications with the London Business Analysts, are we are waiting for feedback from the traders in London.
- We started the mock GUI for the Emerging Markets Division.
- Started to work on E-trading workflow.

What are your goals for next week?

- We will be practicing our 5 minute presentation for the Alumni event.
- Finish writing the paper so we submit the first draft of the paper on the week of Dec 4th.
- Finalize the UI requirements
- Finalize the e-trading workflow

Did you encounter any problems throughout the course of the week?

- Less time because it was a three-day week.

Weekly Report 11/29/2012

What did you accomplish this week?

- Scheduled our MQP meeting room for the final presentation; we will send the meeting invite once we have all the details.
- Discussed the GUI specifications with the London Business Analysts, are we are waiting for feedback from the traders in London.
- Worked on sample GUI for the Emerging Markets Division.
- Worked on E-trading workflow.
- Practiced our 5 minute presentation for the Alumni Event.
- Finished the first 3 chapters of the final report, and we are now double-checking the sections.

What are your goals for next week?

- Finish writing the paper so we submit the first draft on Dec 4th.
- Finalize the UI requirements and design.
- Finalize the e-trading workflow.
- Finalize documentation for Ron's new deliverable.

Did you encounter any problems throughout the course of the week?

- Lack of availability from the sponsors' part. Also we are waiting to get installed in our laptops GDA, which is an application required to complete Ron's new deliverable.

Note: Please give us a list of the people from WPI that will be attending the final presentation.

Weekly Report 12/06/2012

What did you accomplish this week?

- Finished the GUI design for Emerging Markets
- Finished documentation for Ron
- Started creating the slides for the final presentation
- Finished most of the sections of the paper. Only missing review of abstract and exec summary, and completing the results and conclusions sections.

What are your goals for next week?

- Finish writing the paper so we submit the final draft on Dec 12th.
- Finish final presentation slides and practice presenting
- Begin the e-trading workflow.
- Finalize GUI for Ron's deliverable on Index Options Pricing

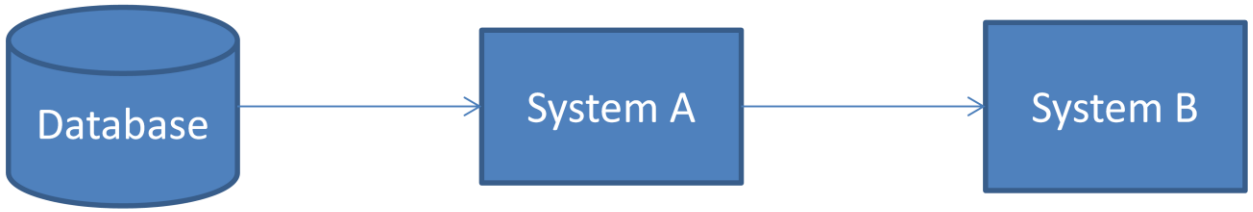
Did you encounter any problems throughout the course of the week?

- E-trading workflow is in standby since we are waiting for Jason to arrange a call with Ketan in London.

Note: Please give us a list of the people from WPI that will be attending the final presentation.

Appendix D – Credit Sales & Trading Workflow Documentation Template

Workflow Diagram



Steps for the workflow

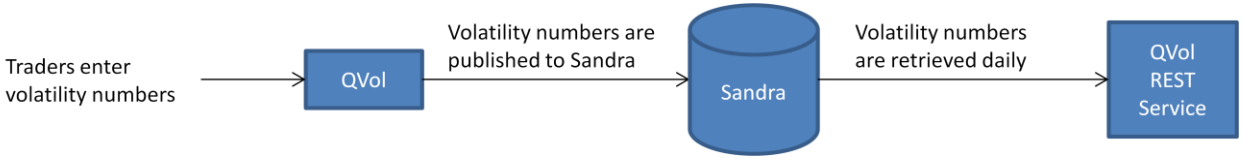
1.
2.
3.
4.
5.
Etc.

Appendix E – Structured Credit Trading Systems Documentation Template

Application Environment Parameters Documentation

This document is to specify settings and configurations for the three Environments (Development, QA, and Production) when…

(Application purpose)



Application Environment Parameters

Application Variables	Development	QA	Production
Variable 1	Settings	Settings	Settings
Variable 2	Settings	Settings	Settings
Variable 3	Settings	Settings	Settings
Variable 3	Settings	Settings	Settings

Variable Definitions

Variable 1: Use of variable 1

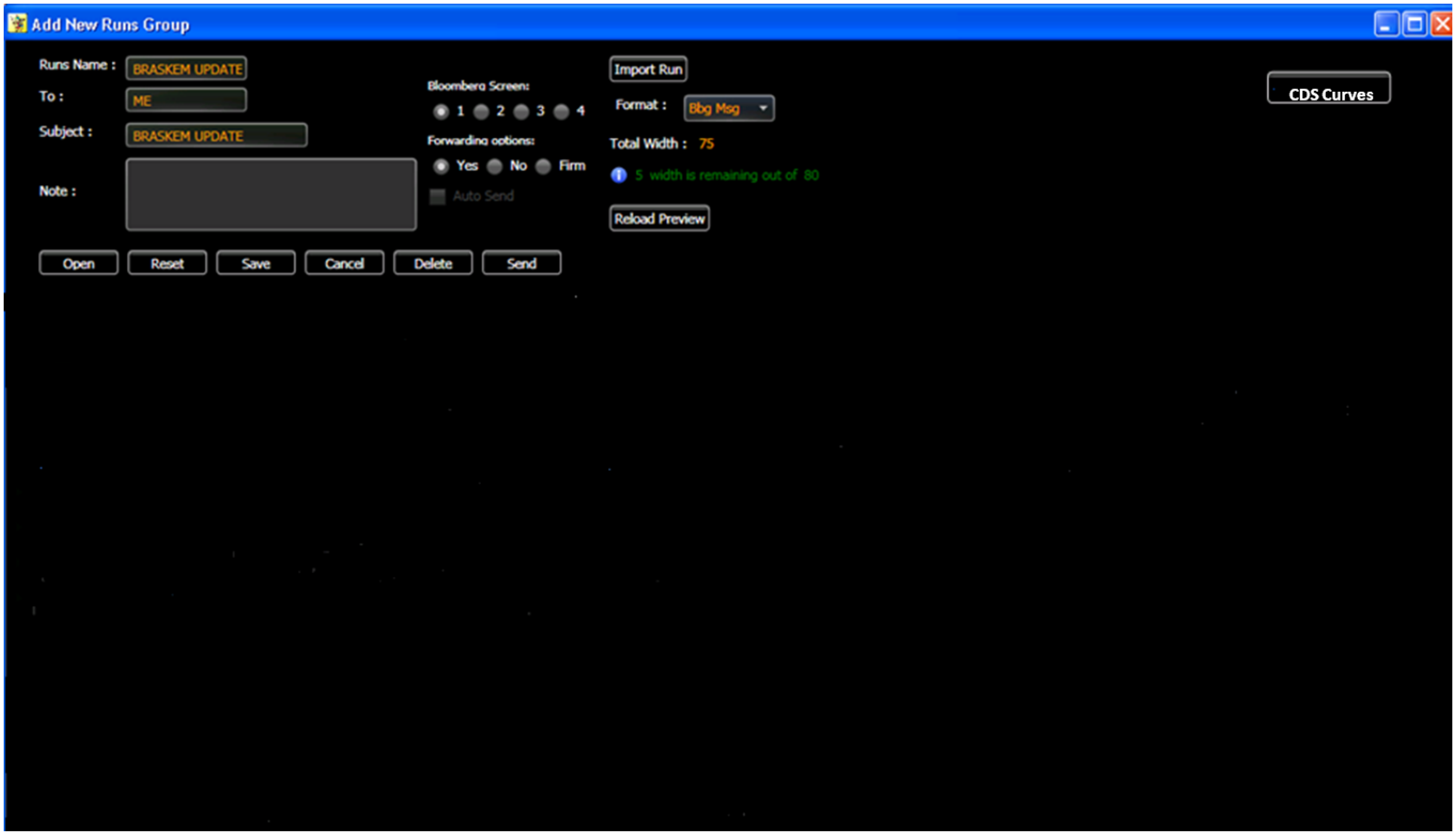
Variable 2: Use of variable 2

Variable 3: Use of variable 3

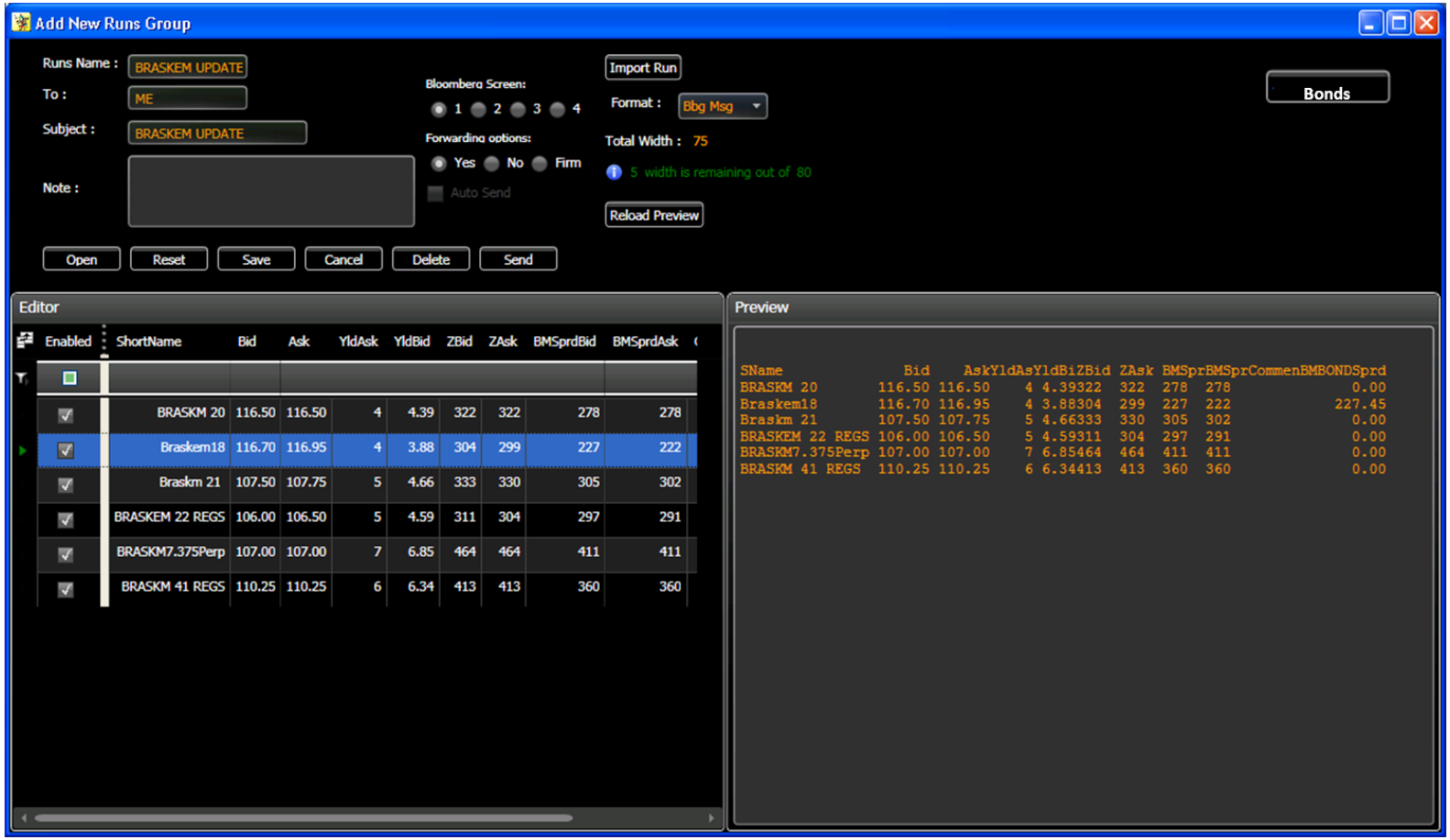
Variable 4: Use of variable 4

Appendix F – Emerging Markets User Interfaces

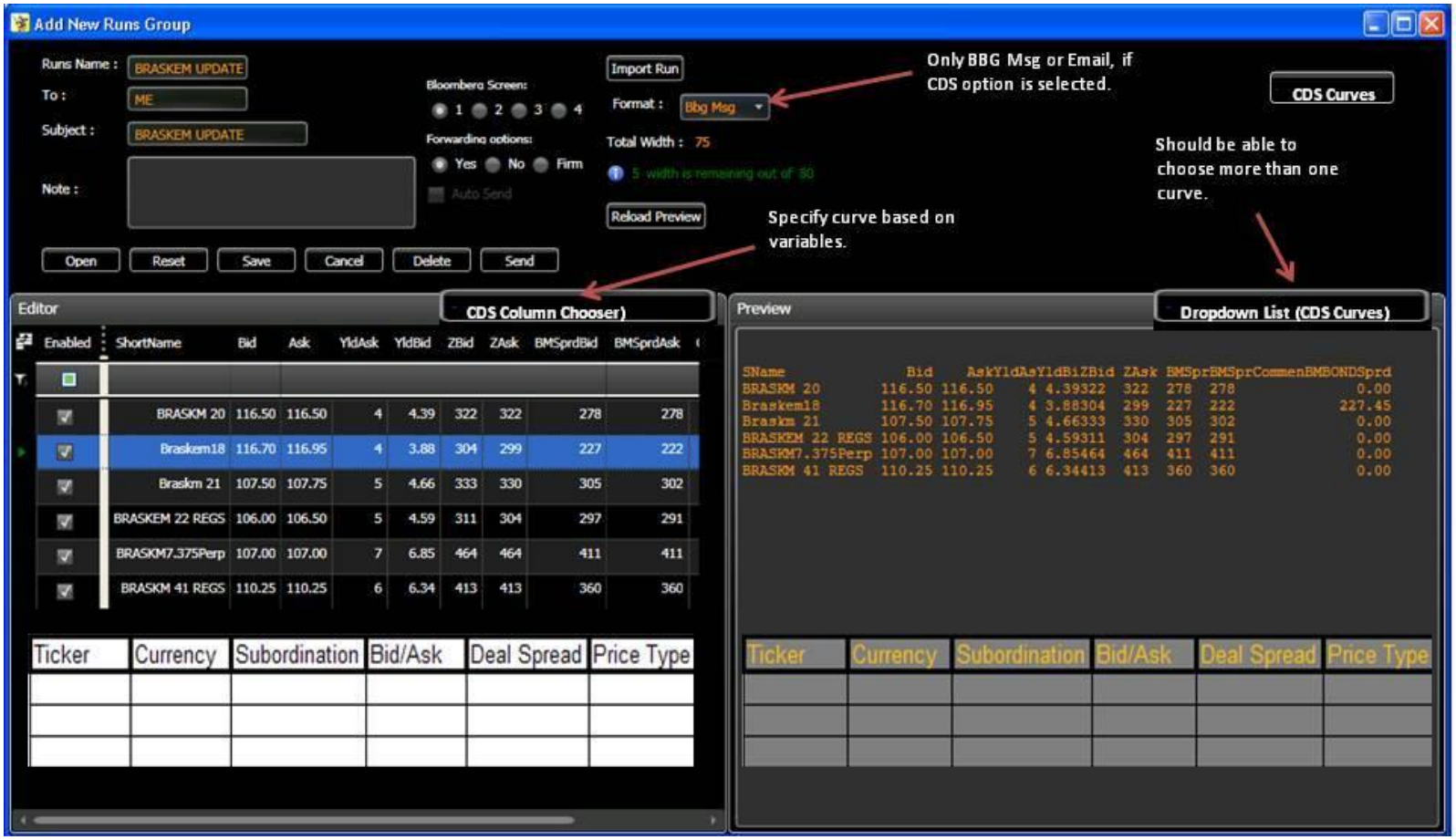
Initial Aquila Interface



Bonds Interface



Credit Default Swaps Interface



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